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$$\triangle=\tfrac{2}{3}\int_0^{\frac{1}{4}\pi}(\tan\theta\sec^2\theta-3\sin\theta\cos\theta-6\tan\theta+8\sin\theta)d\theta$$

$$+\tfrac{4}{3}\int_0^{\frac{1}{4}\pi}(\sec^2\theta-\tan\theta\sec^2\theta-3+3\tan\theta+2\cos\theta-2\sin\theta)d\theta.$$

$\therefore\ \triangle=\frac{19}{6}-\pi.\quad p=1-\triangle=\pi-\frac{13}{6}=$required chance.

PROBLEMS.

44. Proposed by HENRY HEATON, M. Sc., Atlantic, Iowa.

What is the average length of all the chords that may be drawn from one extremity of the major axis of an ellipse if they are drawn at equal angular intervals?

45. Proposed by J. C. WILLIAMS, Boston, Massachusetts.

At the end of the fifth inning the base ball score stands 7 to 9. What is the probability of winning for either team?

46. Proposed by J. A. CALDERHEAD, M. Sc., Professor of Mathematics in Curry University, Pittsburg, Pennsylvania.

Four men starting from random points on the circumference of a circular field and traveling at different rates, take random straight courses across it; find the chance that at least two of them will meet.

◆

MISCELLANEOUS.

Conducted by **J. M. COLAW**, Monterey, Va. All contributions to this department should be sent to him.

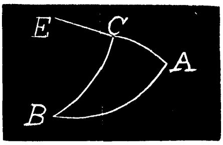
SOLUTIONS OF PROBLEMS.

38. Proposed by S. H. WRIGHT, M. D., A. M., Ph. D., Penn Yan, New York.

In latitude $42^\circ 30'$ north$=\lambda$, at what angle with the horizon will the sun rise, its declination$=22^\circ$ north$=\delta$?

I. Solution by the PROPOSER.

Let BA be a portion of the equator, $CA=\delta$, a portion of a meridian passing through the sun at C when rising, and describing a small-circle arc CE, parallel with BA, and let BC be a portion of the horizon. Then the angles ECA, and BAC, each$=90^\circ$, because meridians cut the equator and circles of declination at right angles. Now $CBA=90^\circ-\lambda$, then $\sin BCA=\sin\lambda\sec\delta=\cos BCE$. $\therefore$ $BCE=43^\circ 13' 37''=$required angle.



II. Solution by G. B. M. ZERR, A. M., Ph. D., Texarkana, Arkansas-Texas.

Let $x^2+z^2=R^2$..............(1) be the equation to the horison. Then, $x\cos\lambda+y\sin\lambda=R\sin\delta$..............(2) is the equation to the plane of the sun's path. (1) and (2) intersect in the points

$$x=\frac{R\sin\delta}{\cos\lambda},\quad y=0,\quad z=\pm\frac{R}{\cos\lambda}\sqrt{\cos^2\lambda-\sin^2\delta}.$$

The equation for the tangent plane for z positive is,

$$x\sin\delta+z\sqrt{\cos^2\lambda-\sin^2\delta}=R\cos\lambda.$$

∴ We must find the angle ϕ between the two lines in space,

$$\left.\begin{array}{r}x\sin\delta+z\sqrt{\cos^2\lambda-\sin^2\delta}=R\cos\lambda\\ x\cos\lambda+y\sin\lambda=R\sin\delta\end{array}\right\}\ldots\ldots\ldots\ldots\ldots\ldots(3),$$

$$\left.\begin{array}{r}x\sin\delta+z\sqrt{\cos^2\lambda-\sin^2\delta}=R\cos\lambda\\ y=0\end{array}\right\}\ldots\ldots\ldots\ldots\ldots\ldots(4).$$

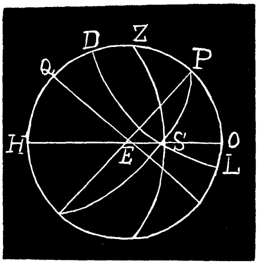
Let $s=\dfrac{\sin\delta}{\sqrt{\cos^2\lambda-\sin^2\delta}}$, $t=\cot\lambda$.

Then $\cos\phi=\dfrac{1+s^2}{\sqrt{(1+s^2)(1+s^2+t^2)}}=\sqrt{\dfrac{1+s^2}{1+s^2+t^2}}$. ∴ $\cos\phi=\dfrac{\sin\lambda}{\cos\delta}$.

∴ $\phi=43^\circ 13'37''$.

III. Solution by J. SCHEFFER, A. M., Hagerstown, Maryland.

Let HO represent the horizon, Z the zenith of the place of observation, EQ the equator, P the north pole, DL the diurnal circle of the sun, and S the position of the sun at rising. In the quadrantal spherical triangle ZPS, we have $ZS=90^\circ$, $ZP=90^\circ-\lambda$, $PS=90^\circ-\delta$.



We find $\cos ZSP=\sin\lambda/\cos\delta$, but $\angle ZSP$ is equal to the angle which a tangent at S of the circle DSL makes with the horizon.

∴ $\cos x=\dfrac{\sin\lambda}{\cos\delta}$, denoting by x the required angle. For the given concrete values we find $x=43^\circ 14'$.

[NOTE.—Prof. H. C. Whittaker obtained as the numerical result for the required angle 70 degrees, 21 minutes, 56 seconds, and Prof. E. W. Morrell obtained 72 degrees, 9 minutes, 4.2 seconds. The result given in the published solutions seems to us to be the correct one.]